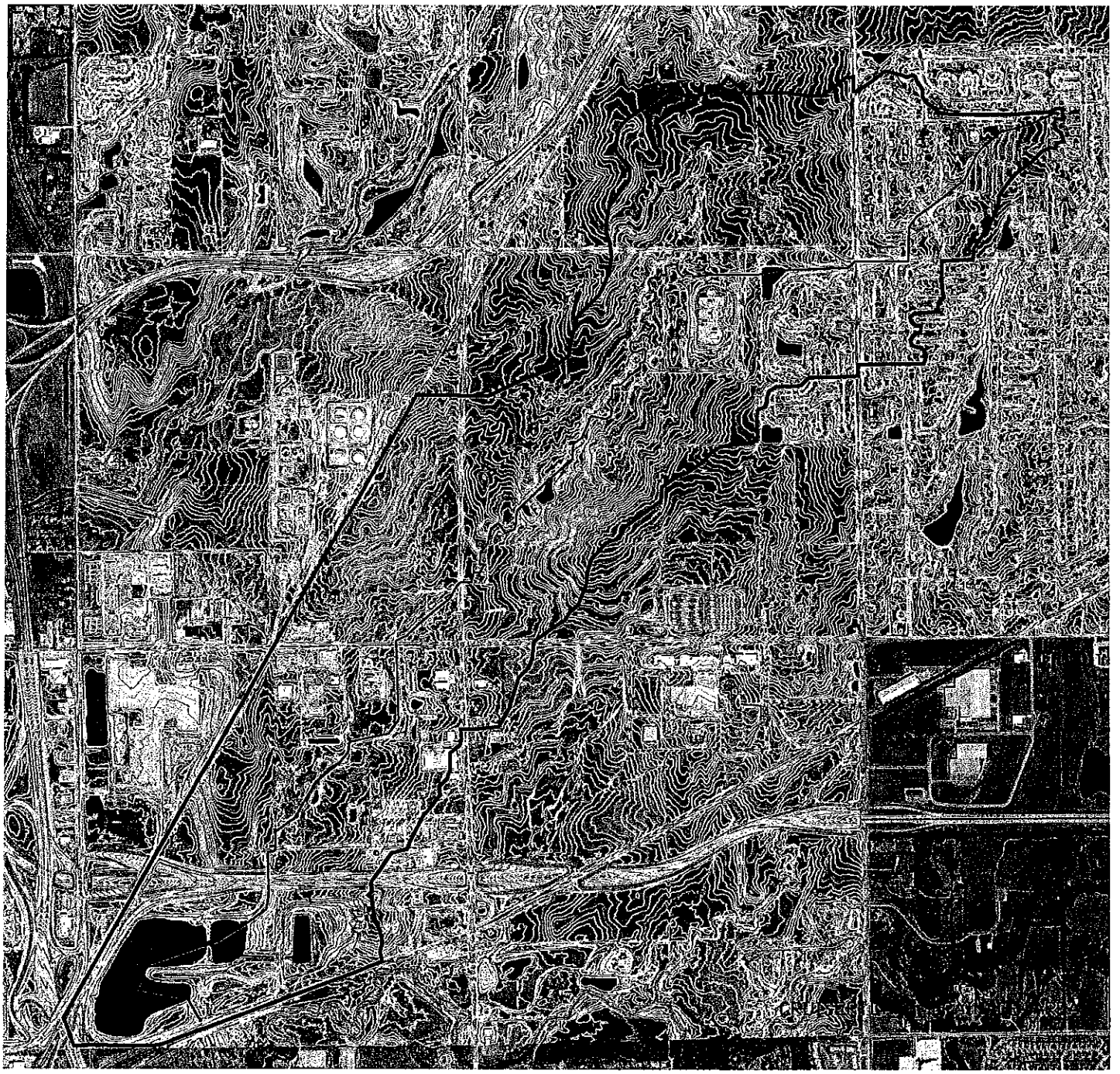
Appendix F
Off-Site Runoff from Cruiser Lake Calculations



CRUISER LAKE
DRAINAGE AREA

N

1" = 2000'

SCS METHOD

$P_2 = 3.5"$ $P_5 = 4.5"$ $P_{10} = 5.2"$ $P_{25} = 6.1"$ $P_{100} = 7.8"$

$S = \frac{1000}{CN} - 10 = \frac{1000}{73} - 10 = 3.70$

CN: Soil Hydrologic Group B

≈ 1/3 dev., 2/3 undev. Farmland

From "Urban Hydrology for Small Watersheds" Tech. Release 55 June 1986

Total Acres = 1177 Ac.

1/3 dev = 1177 (1/3) = 392 Ac

2/3 Cult. land = 785 Ac.

Dev Ac.

3/5 Industrial: 0.6 (392) = 235 Ac CN = 88

2/5 Residential: 0.4 (392) = 157 Ac CN = 72
1/3 Ac. Lots

Undev Ac. (785 Ac)

Pasture - Fair drainage CN = 69

Combined CN:

$\frac{235}{1177}(88) + \frac{157}{1177}(72) + \frac{785}{1177}(69) = 73$

Time of Concentration

$T_{GF} = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} S^{0.4}}$ $\quad n = 0.13\left(\frac{.785}{11.77}\right) + 0.$ $\quad L = 22636$ $\quad S = 2.0\%$

$= \frac{0.007[0.13(300)]^{0.8}}{(3.5)^{0.5}(0.02)^{0.4}} = 0.34\,hr = 20.1\,min$

T_{SC}: $V = 20.3282\,(S)^{1/2} = 20.3282(0.02)^{1/2}$

$= 2.87\,ft/s$

$T_{SC} = \frac{700}{60(2.87)} = 4.0\,min.$

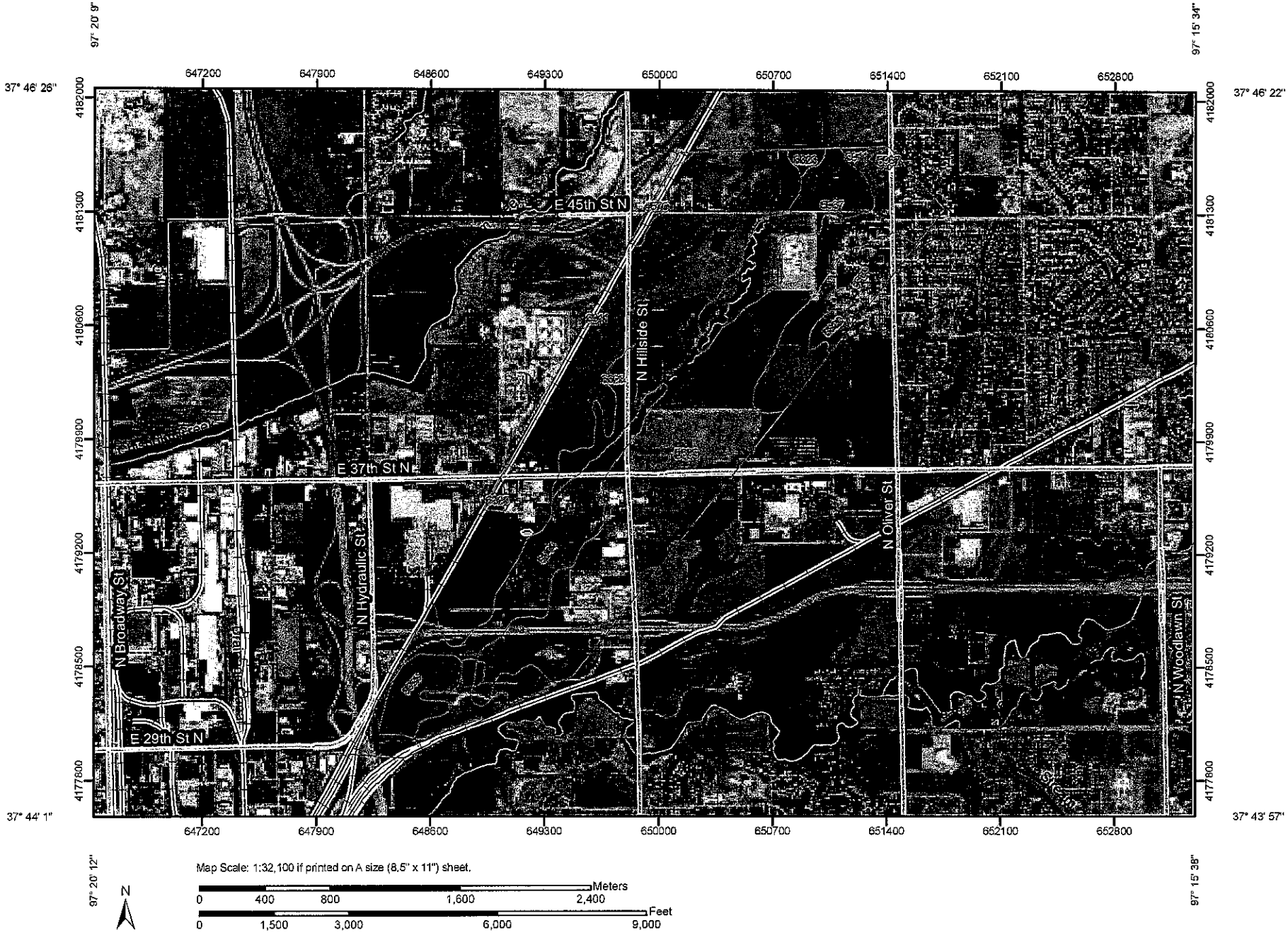
T_{CF}: $V = 1.5(V_{SC}) = 2.87(1.5) = 4.31\,ft/s$

$T_c = \frac{21,636'}{60(4.31)} = 84\,min$

$T_c = 20.1 + 4.0 + 84 = 108.1\,min = 1.8\,hrs$

$I_2' =$

Soil Map—Sedgwick County, Kansas
(Cruiser Lake Watershed)



Map Unit Legend

Sedgwick County, Kansas (KS173)				
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI	
3911	Rosehill silty clay, 1 to 3 percent slopes	7.7	0.6%	D
4570	Clime silty clay, 3 to 7 percent slopes	8.1	0.6%	C
5893	Farnum loam, 1 to 3 percent slopes	826.1	64.8%	B
5967	Tabler silty clay loam, 0 to 1 percent slopes	89.3	7.0%	D
6244	Elandco silt loam, rarely flooded	167.3	13.1%	B
6322	Blanket silt loam, 0 to 1 percent slopes	10.3	0.8%	C
6323	Blanket silt loam, 1 to 3 percent slopes	43.8	3.4%	C
6369	Milan loam, 1 to 3 percent slopes	82.3	6.5%	B
9999	Water	39.7	3.1%	–
Totals for Area of Interest		**1,274.8**	**100.0%**	

Majority is B Soil Hydrologic Group

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:32,100 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 14N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Sedgwick County, Kansas
Survey Area Data: Version 5, Dec 3, 2008

Date(s) aerial images were photographed: 6/20/2006

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:04:13
Watershed file: --> CRUISLWS.WSD
Hydrograph file: --> CRUISLK .HYD

Wichita Readiness Center
Cruiser Lake Watershed
2-year storm event

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Total Area	1177.00	73.0	2.00	0.00	3.50	1.18	.21 .30

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 1177.00 acres or 1.8391 sq.mi
Peak discharge = 401 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	* Tt (hr)	Rounded Values Tc (hr)	* Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Total Area	1.80	0.00	2.00	0.00	No	--

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:04:13
Watershed file: --> CRUISLWS.WSD
Hydrograph file: --> CRUISLK .HYD

Wichita Readiness Center
Cruiser Lake Watershed
2-year storm event

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Total Area	401	13.6
Composite Watershed	401	13.6

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:04:13
Watershed file: --> CRUISLWS.WSD
Hydrograph file: --> CRUISLK .HYD

Wichita Readiness Center
Cruiser Lake Watershed
2-year storm event

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Total Area	0	0	0	0	0	2	7	17	33
Total (cfs)	0	0	0	0	0	2	7	17	33

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Total Area	54	82	117	161	250	321	365	401	369
Total (cfs)	54	82	117	161	250	321	365	401	369

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Total Area	345	284	239	193	152	124	106	91	82
Total (cfs)	345	284	239	193	152	124	106	91	82

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Total Area	74	63	56	43	11
Total (cfs)	74	63	56	43	11

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:04:13
Watershed file: --> CRUISLWS.WSD
Hydrograph file: --> CRUISLK .HYD

Wichita Readiness Center
Cruiser Lake Watershed
2-year storm event

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	0	14.8	216
11.1	0	14.9	204
11.2	0	15.0	193
11.3	0	15.1	185
11.4	0	15.2	177
11.5	0	15.3	168
11.6	0	15.4	160
11.7	0	15.5	152
11.8	0	15.6	146
11.9	0	15.7	141
12.0	0	15.8	135
12.1	2	15.9	130
12.2	7	16.0	124
12.3	17	16.1	120
12.4	33	16.2	117
12.5	54	16.3	113
12.6	82	16.4	110
12.7	117	16.5	106
12.8	161	16.6	103
12.9	206	16.7	100
13.0	250	16.8	97
13.1	286	16.9	94
13.2	321	17.0	91
13.3	343	17.1	89
13.4	365	17.2	87
13.5	383	17.3	86
13.6	401	17.4	84
13.7	385	17.5	82
13.8	369	17.6	80
13.9	357	17.7	79
14.0	345	17.8	77
14.1	325	17.9	76
14.2	304	18.0	74
14.3	284	18.1	73
14.4	269	18.2	72
14.5	254	18.3	71
14.6	239	18.4	70
14.7	228	18.5	68

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:04:13
Watershed file: --> CRUISLWS.WSD
Hydrograph file: --> CRUISLK .HYD

Wichita Readiness Center
Cruiser Lake Watershed
2-year storm event

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	67	22.4	40
18.7	66	22.5	39
18.8	65	22.6	38
18.9	64	22.7	37
19.0	63	22.8	37
19.1	62	22.9	36
19.2	62	23.0	35
19.3	61	23.1	34
19.4	60	23.2	33
19.5	60	23.3	33
19.6	59	23.4	32
19.7	58	23.5	31
19.8	57	23.6	30
19.9	57	23.7	29
20.0	56	23.8	29
20.1	55	23.9	28
20.2	55	24.0	27
20.3	54	24.1	26
20.4	53	24.2	25
20.5	53	24.3	25
20.6	52	24.4	24
20.7	51	24.5	23
20.8	51	24.6	22
20.9	50	24.7	21
21.0	50	24.8	21
21.1	49	24.9	20
21.2	48	25.0	19
21.3	48	25.1	18
21.4	47	25.2	17
21.5	46	25.3	17
21.6	46	25.4	16
21.7	45	25.5	15
21.8	44	25.6	14
21.9	44	25.7	13
22.0	43	25.8	13
22.1	42	25.9	12
22.2	41		
22.3	41		

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:06:09
Watershed file: --> CRUISL05.WSD
Hydrograph file: --> CRUISL05.HYD

Wichita Readiness Center
Cruiser Lake Watershed
5-year storm event

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Total Area	1177.00	73.0	2.00	0.00	4.50	1.90	.16 .10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 1177.00 acres or 1.8391 sq.mi
Peak discharge = 790 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	* Tt (hr)	Rounded Values Tc (hr)	* Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Total Area	1.80	0.00	2.00	0.00	No	--

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:06:09
Watershed file: --> CRUISL05.WSD
Hydrograph file: --> CRUISL05.HYD

Wichita Readiness Center
Cruiser Lake Watershed
5-year storm event

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Total Area	790	13.4
Composite Watershed	790	13.4

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:06:09
Watershed file: --> CRUISL05.WSD
Hydrograph file: --> CRUISL05.HYD

Wichita Readiness Center
Cruiser Lake Watershed
5-year storm event

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Total Area	24	31	42	56	63	73	94	126	171
Total (cfs)	24	31	42	56	63	73	94	126	171

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Total Area	224	287	363	444	598	702	790	727	674
Total (cfs)	224	287	363	444	598	702	790	727	674

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Total Area	598	461	367	276	203	157	126	105	91
Total (cfs)	598	461	367	276	203	157	126	105	91

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Total Area	80	70	59	45	10
Total (cfs)	80	70	59	45	10

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:06:09
Watershed file: --> CRUISL05.WSD
Hydrograph file: --> CRUISL05.HYD

Wichita Readiness Center
Cruiser Lake Watershed
5-year storm event

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	24	14.8	322
11.1	26	14.9	299
11.2	29	15.0	276
11.3	31	15.1	261
11.4	35	15.2	247
11.5	38	15.3	232
11.6	42	15.4	218
11.7	47	15.5	203
11.8	51	15.6	194
11.9	56	15.7	185
12.0	63	15.8	175
12.1	73	15.9	166
12.2	94	16.0	157
12.3	126	16.1	151
12.4	171	16.2	145
12.5	224	16.3	138
12.6	287	16.4	132
12.7	363	16.5	126
12.8	444	16.6	122
12.9	521	16.7	118
13.0	598	16.8	113
13.1	650	16.9	109
13.2	702	17.0	105
13.3	746	17.1	102
13.4	790	17.2	99
13.5	759	17.3	97
13.6	727	17.4	94
13.7	700	17.5	91
13.8	674	17.6	89
13.9	636	17.7	87
14.0	598	17.8	84
14.1	552	17.9	82
14.2	507	18.0	80
14.3	461	18.1	79
14.4	430	18.2	78
14.5	398	18.3	77
14.6	367	18.4	76
14.7	344	18.5	75

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:06:09
Watershed file: --> CRUISL05.WSD
Hydrograph file: --> CRUISL05.HYD

Wichita Readiness Center
Cruiser Lake Watershed
5-year storm event

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	74	22.4	42
18.7	73	22.5	41
18.8	72	22.6	40
18.9	71	22.7	39
19.0	70	22.8	38
19.1	69	22.9	37
19.2	68	23.0	36
19.3	67	23.1	35
19.4	66	23.2	34
19.5	64	23.3	34
19.6	63	23.4	33
19.7	62	23.5	32
19.8	61	23.6	31
19.9	60	23.7	30
20.0	59	23.8	29
20.1	58	23.9	28
20.2	58	24.0	28
20.3	57	24.1	27
20.4	56	24.2	26
20.5	56	24.3	25
20.6	55	24.4	24
20.7	54	24.5	23
20.8	53	24.6	22
20.9	53	24.7	21
21.0	52	24.8	20
21.1	51	24.9	20
21.2	51	25.0	19
21.3	50	25.1	18
21.4	49	25.2	17
21.5	48	25.3	16
21.6	48	25.4	15
21.7	47	25.5	14
21.8	46	25.6	14
21.9	46	25.7	13
22.0	45	25.8	12
22.1	44	25.9	11
22.2	43		
22.3	42		

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:07:13
Watershed file: --> CRUISL10.WSD
Hydrograph file: --> CRUISL10.HYD

Wichita Readiness Center
Cruiser Lake Watershed
10-year storm event

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Total Area	1177.00	73.0	2.00	0.00	5.20	2.44	.14 .10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 1177.00 acres or 1.8391 sq.mi
Peak discharge = 1014 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Total Area	1.80	0.00	2.00	0.00	No	--

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:07:13
Watershed file: --> CRUISL10.WSD
Hydrograph file: --> CRUISL10.HYD

Wichita Readiness Center
Cruiser Lake Watershed
10-year storm event

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Total Area	1014	13.4
Composite Watershed	1014	13.4

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:07:13
Watershed file: --> CRUISL10.WSD
Hydrograph file: --> CRUISL10.HYD

Wichita Readiness Center
Cruiser Lake Watershed
10-year storm event

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Total Area	31	40	54	72	81	94	121	162	220
Total (cfs)	31	40	54	72	81	94	121	162	220

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Total Area	287	368	467	570	767	902	1014	933	866
Total (cfs)	287	368	467	570	767	902	1014	933	866

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Total Area	767	592	471	354	260	202	162	135	117
Total (cfs)	767	592	471	354	260	202	162	135	117

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Total Area	103	90	76	58	13
Total (cfs)	103	90	76	58	13

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:07:13
Watershed file: --> CRUISL10.WSD
Hydrograph file: --> CRUISL10.HYD

Wichita Readiness Center
Cruiser Lake Watershed
10-year storm event

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	31	14.8	412
11.1	34	14.9	383
11.2	37	15.0	354
11.3	40	15.1	335
11.4	45	15.2	316
11.5	49	15.3	298
11.6	54	15.4	279
11.7	60	15.5	260
11.8	66	15.6	248
11.9	72	15.7	237
12.0	81	15.8	225
12.1	94	15.9	214
12.2	121	16.0	202
12.3	162	16.1	194
12.4	220	16.2	186
12.5	287	16.3	178
12.6	368	16.4	170
12.7	467	16.5	162
12.8	570	16.6	157
12.9	669	16.7	151
13.0	767	16.8	146
13.1	835	16.9	140
13.2	902	17.0	135
13.3	958	17.1	131
13.4	1014	17.2	128
13.5	974	17.3	124
13.6	933	17.4	121
13.7	899	17.5	117
13.8	866	17.6	114
13.9	816	17.7	111
14.0	767	17.8	109
14.1	709	17.9	106
14.2	650	18.0	103
14.3	592	18.1	102
14.4	552	18.2	100
14.5	511	18.3	99
14.6	471	18.4	98
14.7	442	18.5	96

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:07:13
Watershed file: --> CRUISL10.WSD
Hydrograph file: --> CRUISL10.HYD

Wichita Readiness Center
Cruiser Lake Watershed
10-year storm event

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	95	22.4	54
18.7	94	22.5	52
18.8	93	22.6	51
18.9	91	22.7	50
19.0	90	22.8	49
19.1	89	22.9	48
19.2	87	23.0	47
19.3	86	23.1	46
19.4	84	23.2	44
19.5	83	23.3	43
19.6	82	23.4	42
19.7	80	23.5	41
19.8	79	23.6	40
19.9	77	23.7	39
20.0	76	23.8	38
20.1	75	23.9	37
20.2	74	24.0	36
20.3	73	24.1	34
20.4	72	24.2	33
20.5	72	24.3	32
20.6	71	24.4	31
20.7	70	24.5	30
20.8	69	24.6	29
20.9	68	24.7	28
21.0	67	24.8	26
21.1	66	24.9	25
21.2	65	25.0	24
21.3	64	25.1	23
21.4	63	25.2	22
21.5	62	25.3	21
21.6	62	25.4	20
21.7	61	25.5	19
21.8	60	25.6	18
21.9	59	25.7	16
22.0	58	25.8	15
22.1	57	25.9	14
22.2	56		
22.3	55		

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:07:58
Watershed file: --> CRUISL25.WSD
Hydrograph file: --> CRUISL25.HYD

Wichita Readiness Center
Cruiser Lake Watershed
25-year storm event

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Total Area	1177.00	73.0	2.00	0.00	6.10	3.17	.12 .10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 1177.00 acres or 1.8391 sq.mi
Peak discharge = 1318 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Total Area	1.80	0.00	2.00	0.00	No	--

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:07:58
Watershed file: --> CRUISL25.WSD
Hydrograph file: --> CRUISL25.HYD

Wichita Readiness Center
Cruiser Lake Watershed
25-year storm event

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Total Area	1318	13.4
Composite Watershed	1318	13.4

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:07:58
Watershed file: --> CRUISL25.WSD
Hydrograph file: --> CRUISL25.HYD

Wichita Readiness Center
Cruiser Lake Watershed
25-year storm event

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Total Area	41	52	70	93	105	122	157	210	286
Total (cfs)	41	52	70	93	105	122	157	210	286

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Total Area	373	478	606	740	997	1172	1318	1213	1125
Total (cfs)	373	478	606	740	997	1172	1318	1213	1125

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Total Area	997	770	612	461	338	262	210	175	152
Total (cfs)	997	770	612	461	338	262	210	175	152

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Total Area	134	117	99	76	17
Total (cfs)	134	117	99	76	17

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:07:58
Watershed file: --> CRUISL25.WSD
Hydrograph file: --> CRUISL25.HYD

Wichita Readiness Center
Cruiser Lake Watershed
25-year storm event

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	41	14.8	536
11.1	45	14.9	499
11.2	48	15.0	461
11.3	52	15.1	436
11.4	58	15.2	412
11.5	64	15.3	387
11.6	70	15.4	363
11.7	78	15.5	338
11.8	85	15.6	323
11.9	93	15.7	308
12.0	105	15.8	292
12.1	122	15.9	277
12.2	157	16.0	262
12.3	210	16.1	252
12.4	286	16.2	241
12.5	373	16.3	231
12.6	478	16.4	220
12.7	606	16.5	210
12.8	740	16.6	203
12.9	869	16.7	196
13.0	997	16.8	189
13.1	1084	16.9	182
13.2	1172	17.0	175
13.3	1245	17.1	170
13.4	1318	17.2	166
13.5	1266	17.3	161
13.6	1213	17.4	157
13.7	1169	17.5	152
13.8	1125	17.6	148
13.9	1061	17.7	145
14.0	997	17.8	141
14.1	921	17.9	138
14.2	846	18.0	134
14.3	770	18.1	132
14.4	717	18.2	131
14.5	665	18.3	129
14.6	612	18.4	127
14.7	574	18.5	126

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:07:58
Watershed file: --> CRUISL25.WSD
Hydrograph file: --> CRUISL25.HYD

Wichita Readiness Center
Cruiser Lake Watershed
25-year storm event

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	124	22.4	70
18.7	122	22.5	69
18.8	120	22.6	67
18.9	119	22.7	66
19.0	117	22.8	64
19.1	115	22.9	63
19.2	113	23.0	61
19.3	112	23.1	60
19.4	110	23.2	58
19.5	108	23.3	57
19.6	106	23.4	55
19.7	104	23.5	54
19.8	103	23.6	52
19.9	101	23.7	51
20.0	99	23.8	49
20.1	98	23.9	48
20.2	97	24.0	46
20.3	96	24.1	45
20.4	94	24.2	44
20.5	93	24.3	42
20.6	92	24.4	41
20.7	91	24.5	39
20.8	90	24.6	38
20.9	89	24.7	36
21.0	88	24.8	35
21.1	86	24.9	33
21.2	85	25.0	32
21.3	84	25.1	30
21.4	83	25.2	29
21.5	82	25.3	27
21.6	81	25.4	26
21.7	79	25.5	24
21.8	78	25.6	23
21.9	77	25.7	21
22.0	76	25.8	20
22.1	75	25.9	18
22.2	73		
22.3	72		

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:08:58
Watershed file: --> CRUISL00.WSD
Hydrograph file: --> CRUISL00.HYD

Wichita Readiness Center
Cruiser Lake Watershed
100-year storm event

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Total Area	1177.00	73.0	2.00	0.00	7.80	4.63	.09 .10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 1177.00 acres or 1.8391 sq.mi
Peak discharge = 1924 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Total Area	1.80	0.00	2.00	0.00	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:08:58
Watershed file: --> CRUISL00.WSD
Hydrograph file: --> CRUISL00.HYD

Wichita Readiness Center
Cruiser Lake Watershed
100-year storm event

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Total Area	1924	13.4
Composite Watershed	1924	13.4

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:08:58
Watershed file: --> CRUISL00.WSD
Hydrograph file: --> CRUISL00.HYD

Wichita Readiness Center
Cruiser Lake Watershed
100-year storm event

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Total Area	60	77	102	136	153	179	230	307	417
Total (cfs)	60	77	102	136	153	179	230	307	417

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Total Area	545	698	886	1081	1456	1711	1924	1771	1643
Total (cfs)	545	698	886	1081	1456	1711	1924	1771	1643

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Total Area	1456	1124	894	673	494	383	307	255	221
Total (cfs)	1456	1124	894	673	494	383	307	255	221

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Total Area	196	170	145	111	26
Total (cfs)	196	170	145	111	26

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:08:58
Watershed file: --> CRUISL00.WSD
Hydrograph file: --> CRUISL00.HYD

Wichita Readiness Center
Cruiser Lake Watershed
100-year storm event

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	60	14.8	783
11.1	66	14.9	728
11.2	71	15.0	673
11.3	77	15.1	637
11.4	85	15.2	601
11.5	94	15.3	566
11.6	102	15.4	530
11.7	113	15.5	494
11.8	125	15.6	472
11.9	136	15.7	450
12.0	153	15.8	427
12.1	179	15.9	405
12.2	230	16.0	383
12.3	307	16.1	368
12.4	417	16.2	353
12.5	545	16.3	337
12.6	698	16.4	322
12.7	886	16.5	307
12.8	1081	16.6	297
12.9	1268	16.7	286
13.0	1456	16.8	276
13.1	1584	16.9	265
13.2	1711	17.0	255
13.3	1818	17.1	248
13.4	1924	17.2	241
13.5	1848	17.3	235
13.6	1771	17.4	228
13.7	1707	17.5	221
13.8	1643	17.6	216
13.9	1550	17.7	211
14.0	1456	17.8	206
14.1	1345	17.9	201
14.2	1235	18.0	196
14.3	1124	18.1	193
14.4	1047	18.2	191
14.5	971	18.3	188
14.6	894	18.4	186
14.7	839	18.5	183

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 09-30-2009 11:08:58
Watershed file: --> CRUISL00.WSD
Hydrograph file: --> CRUISL00.HYD

Wichita Readiness Center
Cruiser Lake Watershed
100-year storm event

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	180	22.4	102
18.7	178	22.5	100
18.8	175	22.6	98
18.9	173	22.7	96
19.0	170	22.8	94
19.1	168	22.9	92
19.2	165	23.0	90
19.3	162	23.1	88
19.4	160	23.2	86
19.5	158	23.3	83
19.6	155	23.4	81
19.7	152	23.5	79
19.8	150	23.6	77
19.9	148	23.7	75
20.0	145	23.8	73
20.1	143	23.9	71
20.2	142	24.0	68
20.3	140	24.1	66
20.4	138	24.2	64
20.5	136	24.3	62
20.6	135	24.4	60
20.7	133	24.5	58
20.8	131	24.6	56
20.9	130	24.7	54
21.0	128	24.8	52
21.1	126	24.9	49
21.2	125	25.0	47
21.3	123	25.1	45
21.4	121	25.2	43
21.5	120	25.3	41
21.6	118	25.4	39
21.7	116	25.5	37
21.8	114	25.6	34
21.9	113	25.7	32
22.0	111	25.8	30
22.1	109	25.9	28
22.2	107		
22.3	105		

HY-8 Culvert Analysis Report

Table 1 - Summary of Culvert Flows at Crossing: Crossing 1

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1323.11	790.00	790.00	0.00	1
1324.15	842.80	842.80	0.00	1
1325.28	895.60	895.60	0.00	1
1326.08	948.40	931.31	16.81	10
1326.19	1001.20	936.13	64.34	7
1326.21	1014.00	937.09	76.23	5
1326.35	1106.80	942.96	163.19	6
1326.41	1159.60	945.77	213.11	5
1326.47	1212.40	948.37	263.60	5
1326.53	1265.20	950.74	313.40	4
1326.58	1318.00	953.03	364.16	4
1326.00	927.88	927.88	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing 1

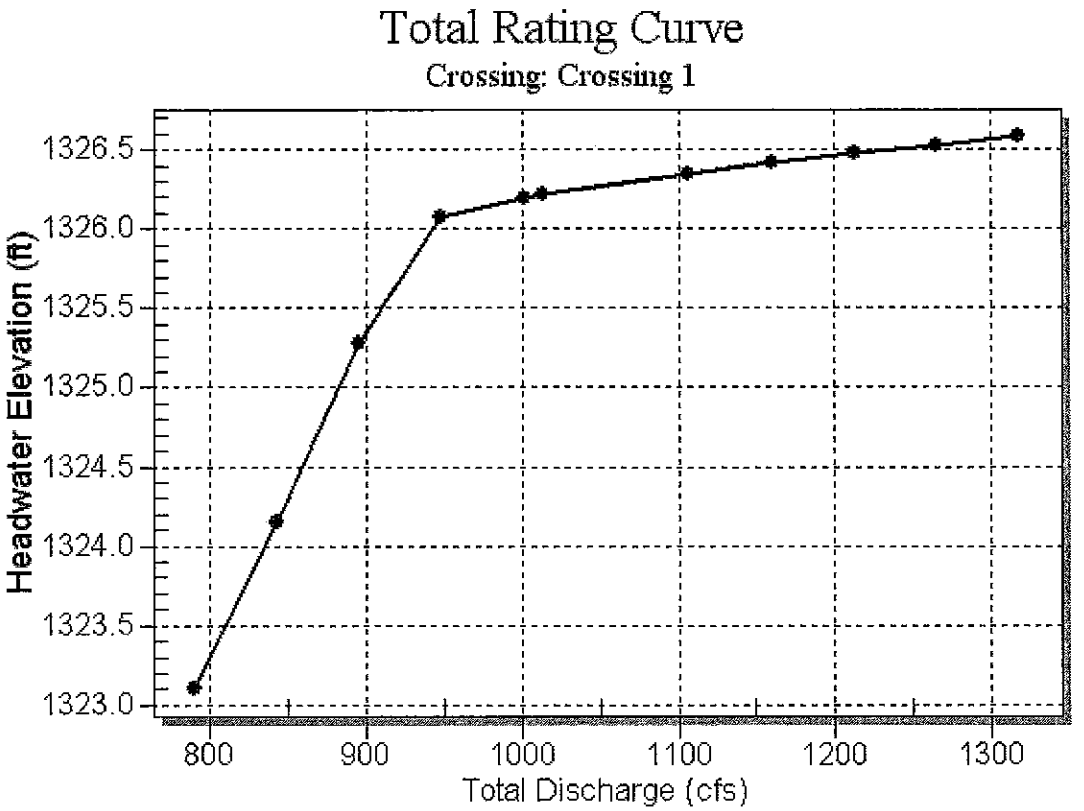


Table 2 - Culvert Summary Table: Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
790.00	790.00	1323.11	13.316	4.443	5-S2n	5.770	6.972	6.202	4.443	17.841	8.890
842.80	842.80	1324.15	14.362	4.644	5-S2n	6.062	7.150	6.464	4.644	18.242	9.074
895.60	895.60	1325.28	15.485	4.843	5-S2n	6.387	7.328	6.704	4.843	18.674	9.247
948.40	931.31	1326.08	16.289	5.039	5-S2n	6.607	7.448	6.897	5.039	18.910	9.410
1001.20	936.13	1326.19	16.400	5.232	5-S2n	6.637	7.464	6.932	5.232	18.926	9.568
1014.00	937.09	1326.21	16.422	5.279	5-S2n	6.643	7.467	6.937	5.279	18.933	9.604
1106.80	942.96	1326.35	16.558	0.0*	5-S2n	6.679	7.487	6.982	5.611	18.948	9.862
1159.60	945.77	1326.41	16.624	0.0*	5-S2n	6.696	7.497	7.004	5.798	18.956	9.999
1212.40	948.37	1326.47	16.685	0.0*	5-S2n	6.712	7.505	7.022	5.982	18.965	10.134
1265.20	950.74	1326.53	16.741	0.0*	5-S2n	6.727	7.513	7.039	6.166	18.973	10.260
1318.00	953.03	1326.58	16.794	0.0*	5-S2n	6.741	7.521	7.056	6.347	18.981	10.383

* theoretical depth is impractical. Depth reported is corrected.

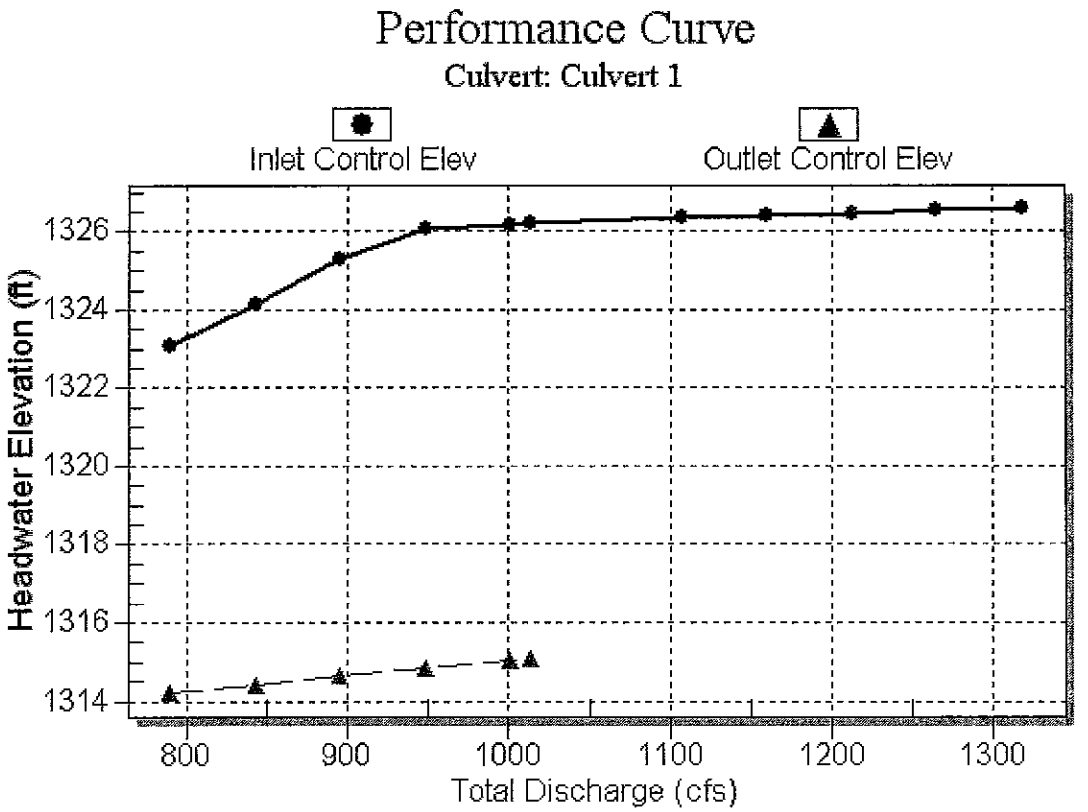
****

Inlet Elevation (invert): 1309.79 ft, Outlet Elevation (invert): 1308.68 ft

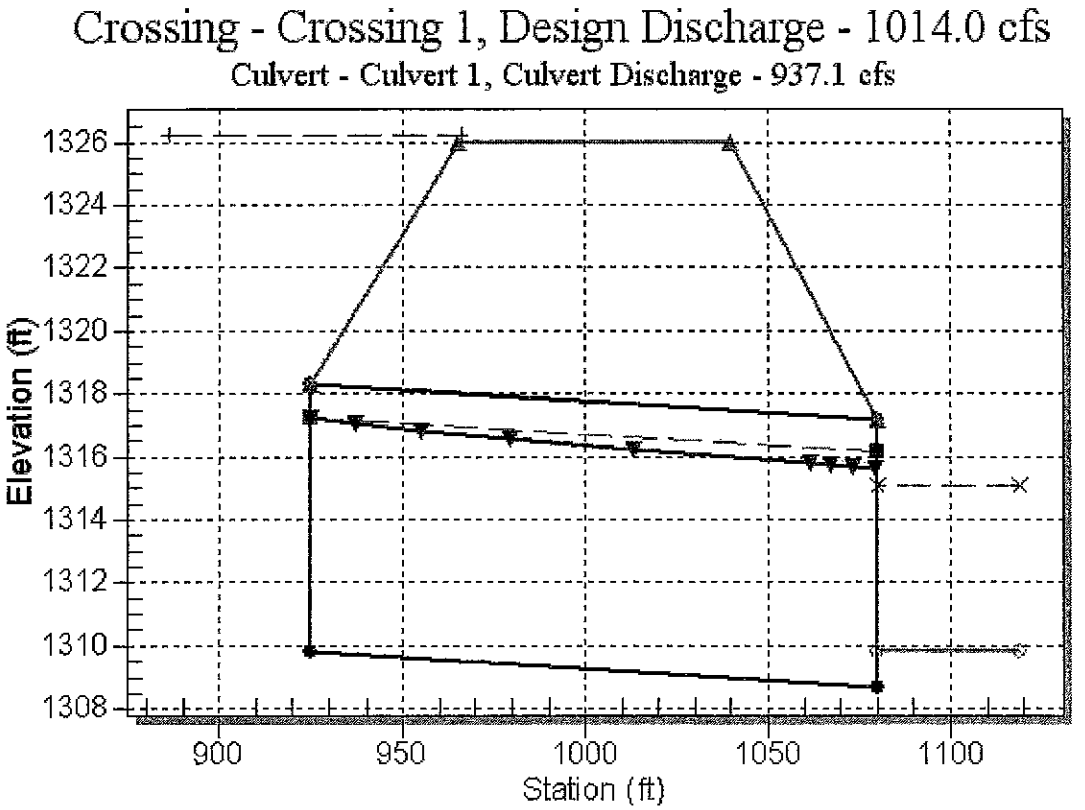
Culvert Length: 155.00 ft, Culvert Slope: 0.0072

****

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 925.00 ft

Inlet Elevation: 1309.79 ft

Outlet Station: 1080.00 ft

Outlet Elevation: 1308.68 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 8.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Square Edge with Headwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 1)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
790.00	1314.23	4.44	8.89	2.00	0.74
842.80	1314.43	4.64	9.07	2.09	0.74
895.60	1314.63	4.84	9.25	2.18	0.74
948.40	1314.83	5.04	9.41	2.26	0.74
1001.20	1315.02	5.23	9.57	2.35	0.74
1014.00	1315.07	5.28	9.60	2.37	0.74
1106.80	1315.40	5.61	9.86	2.52	0.73
1159.60	1315.59	5.80	10.00	2.61	0.73
1212.40	1315.77	5.98	10.13	2.69	0.73
1265.20	1315.96	6.17	10.26	2.77	0.73
1318.00	1316.14	6.35	10.38	2.85	0.73

Tailwater Channel Data - Crossing 1

Tailwater Channel Option: Rectangular Channel

Bottom Width: 20.00 ft

Channel Slope: 0.0072

Channel Manning's n: 0.0300

Channel Invert Elevation: 1309.79 ft

Roadway Data for Crossing: Crossing 1

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 1326.00 ft

Roadway Surface: Gravel

Roadway Top Width: 75.00 ft

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Crossing 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
400.00	400.00	1317.35	7.56	0.0*	1-S2n	3.76	4.98	4.11	2.82	14.73	7.10
552.50	552.50	1319.28	9.49	0.0*	5-S2n	4.55	5.90	4.97	3.49	16.02	7.92
705.00	705.00	1321.58	11.79	4.11	5-S2n	5.33	6.64	5.77	4.11	17.21	8.57
857.50	857.50	1324.46	14.67	4.70	5-S2n	6.15	7.20	6.53	4.70	18.36	9.12
1010.00	936.82	1326.21	16.42	5.26	5-S2n	6.64	7.47	6.94	5.26	18.93	9.59
1162.50	945.93	1326.42	16.63	0.0*	5-S2n	6.70	7.50	7.00	5.81	18.96	10.01
1315.00	952.90	1326.58	16.79	0.0*	5-S2n	6.74	7.52	7.06	6.34	18.98	10.38
1320.00	953.12	1326.59	16.80	0.0*	5-S2n	6.74	7.52	7.06	6.35	18.98	10.39
1620.00	964.22	1326.85	17.06	15.20	5-S1t	6.82	7.56	8.47	7.36	17.03	11.01
1772.50	969.11	1326.97	17.18	15.72	4-FFf	6.86	7.58	6.86	7.85	19.76	11.28
1925.00	973.70	1327.08	17.29	16.28	4-FFf	6.91	7.59	6.91	8.34	19.74	11.54

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: Crossing 1

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1317.35	400.00	400.00	0.00	1
1319.28	552.50	552.50	0.00	1
1321.58	705.00	705.00	0.00	1
1324.46	857.50	857.50	0.00	1
1326.21	1010.00	936.82	72.87	8
1326.42	1162.50	945.93	216.03	6
1326.58	1315.00	952.90	361.26	5
1326.59	1320.00	953.12	366.23	3
1326.85	1620.00	964.22	655.41	5
1326.97	1772.50	969.11	802.65	4
1327.08	1925.00	973.70	950.90	4
1326.00	927.88	927.88	0.00	Overtopping